## ■Description

IPS009BL9 and IPS009BL9A are the specific SPXO IC for achieving 32.768kHz output by divide, corresponding to the fundamental crystal from 14MHz to 27MHz corresponding to each IC.

The power consumption of these IC is quite low, so IPS009BL9 and IPS009BL9A suit for mobile application.

## ■ Features

- Divide function : 1/512
- Crystal frequency : 14MHz to 27MHz
- Operation temperature : -40℃~125℃
- Power supply voltage : 1.6V~5.5V
- Standby function : Oscillation stop
- Output : CMOS
- Small chip size : 0.70mm × 0.75mm
- Frequency stability to Vdd : Within ±1ppm
- Duty cycle : Within 50%±5%

## 1. Part number rule

IPS009BLz A −C3 −W 1

- IPS: Series Name For SPXO
- 009: Product Series
- B: Crystal Frequency Range 14MHz～27MHz
- L: $V_{DD}$ 1.6V~5.5V
- z: Divide Function 9 : 1/512 Divide
- A: Optional Code
- −C3: Pad Layout C3 : Cross
- −W: IC Form
- 1: Thickness

| IC Form | Thickness | Definition |
|---|---|---|
| −W | 0 | Wafer 100um |
| | 1 | Wafer 150um |
| Blank or −C | Blank | Chip 150um |

## 2. Series

| Part Number | Crystal Frequency f (MHz) | | Divide | Output Frequency F0 (kHz) | | Pad Layout | $V_{DD}$ (V) | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | | Min. | Max. | | | |
| IPS009 BL 9 -C3 | 16.777 | | 1/512 | 32.768 | | Cross | 1.62 ~5.5 | AT-cut Crystal |
| IPS009 BL 9 A -C3 | 14.000 | 27.000 | | 27.3 | 52.7 | | | |

## 3. Absolute Maximum Ratings

$V_{SS}$=0V, Ta=25℃±2℃

| Parameter | Symbol | Condition | Ratings | | Unit |
|---|---|---|---|---|---|
| | | | Min | Max | |
| Supply Voltage | $V_{DD}$ | | $V_{SS}$-0.5 | 7.0 | V |
| Input Voltage | $V_{IN}$ | All Input Pin | $V_{SS}$-0.5 | $V_{DD}$+0.5 | V |
| Output Voltage | $V_{OUT}$ | | $V_{SS}$-0.5 | $V_{DD}$+0.5 | V |
| Output Current | $I_{OUT}$ | | | 25 | mA |
| Junction Temperature | Tj | | -55 | 150 | ℃ |
| Storage Temperature | Tstg | | -55 | 125 | ℃ |

## 4. Recommended Operating Condition

$V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | | | 1.6 | 3.3 | 5.5 | V | $V_{DD}$ |
| “H” Input Voltage | $V_{IH}$ | | | $V_{DD}$×0.7 | | | V | CE |
| “L” Input Voltage | $V_{IL}$ | | | | | $V_{DD}$×0.3 | V | CE |
| Input Voltage | $V_{IN}$ | | | $V_{SS}$ | | $V_{DD}$ | V | CE |
| Output Load Capacitance | CL | CMOS | IPS009BL9 | | | 30 | pF | OUT |
| | | | IPS009BL9A | | | 15 | | |
| Ambient Temperature | Topt | | | -40 | | 125 | ℃ | |

This IC has enough immunity against ESD and Latch-up, but handle with care.

## 5. Electrical Specification

### 5-1 IPS009BL9

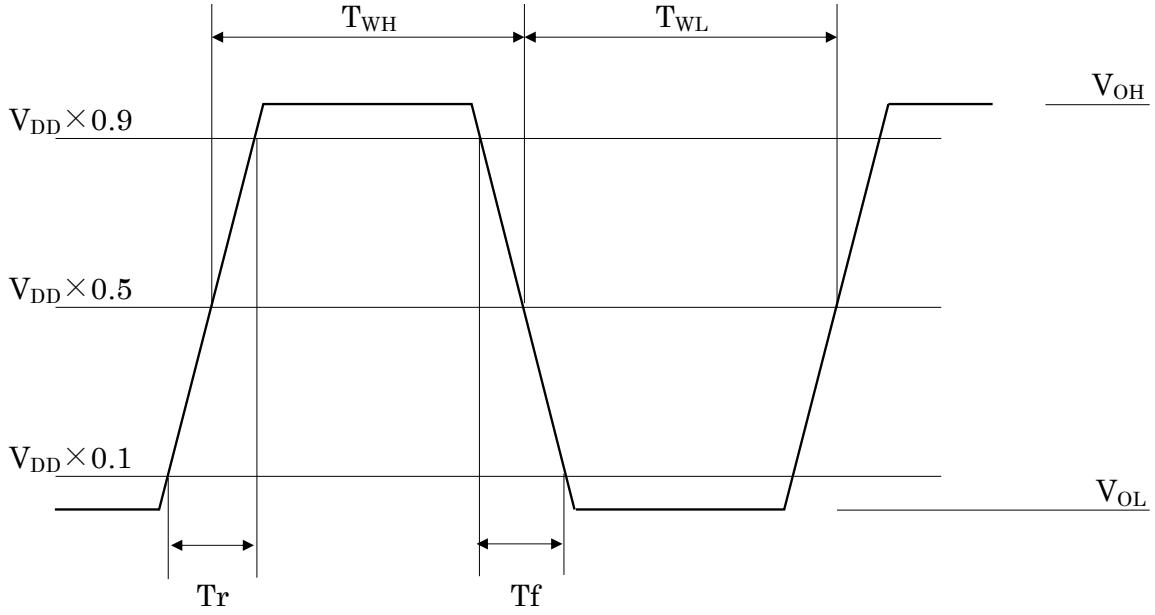
Unless otherwise stated, $V_{DD}$=1.6V~5.5V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | Specification | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Out put Leak current | Iz | CE=0V, X1=$V_{DD}$, Vss<br>Vout=Vss~$V_{DD}$ | | | 20 | μA |
| "H" input current | $I_{IH}$ | CE pad, $V_{IH}$=$V_{DD}$ | | 0.01 | 0.15 | μA |
| "L" input current | $I_{IL}$ | CE pad, $V_{IL}$=0V | -1.45 | -1.25 | | |
| Output Disable Time | Tplz | OUT pad | | | 0.1 | μs |
| Output Enable Time | Tpzl | OUT pad | | | 2.0 | ms |
| Osc. start up time | Tstart | $V_{DD}$>1.6V | | | 2.0 | ms |
| "H" output voltage | $V_{OH}$ | OUT pad, $I_{OH}$=-1.0mA | 0.9$V_{DD}$ | | | V |
| "L" output voltage | $V_{OL}$ | OUT pad, $I_{OL}$=1.0mA | | | 0.1$V_{DD}$ | V |
| Current consumption<br>*CE≧$V_{DD}$-0.3V<br>f=16.777MHz | $I_{DD}$ | CL=15pF, $V_{DD}$=3.63V | | 56 | 115 | μA |
| | | CL=15pF, $V_{DD}$=5.5V | | 64 | 130 | |
| | | CL=30pF, $V_{DD}$=1.8V | | 52 | 110 | |
| | | CL=30pF, $V_{DD}$=3.63V | | 58 | 120 | |
| | | CL=30pF, $V_{DD}$=5.5V | | 67 | 140 | |
| Current consumption at oscillation disable | $I_{DDD}$ | CL=15pF, $V_{DD}$=3.3V<br>CE≦0.3V | | 1.0 | 3.0 | μA |
| Freq. $V_{DD}$ deviation | Fvst | $V_{DD}$=3.3±10% | | | ±1.0 | ppm |
| Output Duty Ratio | Duty | 1/2$V_{DD}$ point | 45 | | 55 | % |
| Rise/Fall time | Tr/Tf | 10%~90%$V_{DD}$, CL=15pF<br>$V_{DD}$=1.62V~2.5V | | 5.5 | 14.0 | ns |
| | | 10%~90%$V_{DD}$, CL=15pF<br>$V_{DD}$=2.5V~5.5V | | 3.0 | 10.0 | |
| | | 10%~90%$V_{DD}$, CL=30pF<br>$V_{DD}$=1.62V~2.5V | | 8.0 | 18.0 | |
| | | 10%~90%$V_{DD}$, CL=30pF<br>$V_{DD}$=2.5V~5.5V | | 5.0 | 13.0 | |

5-2 IPS009BL9A

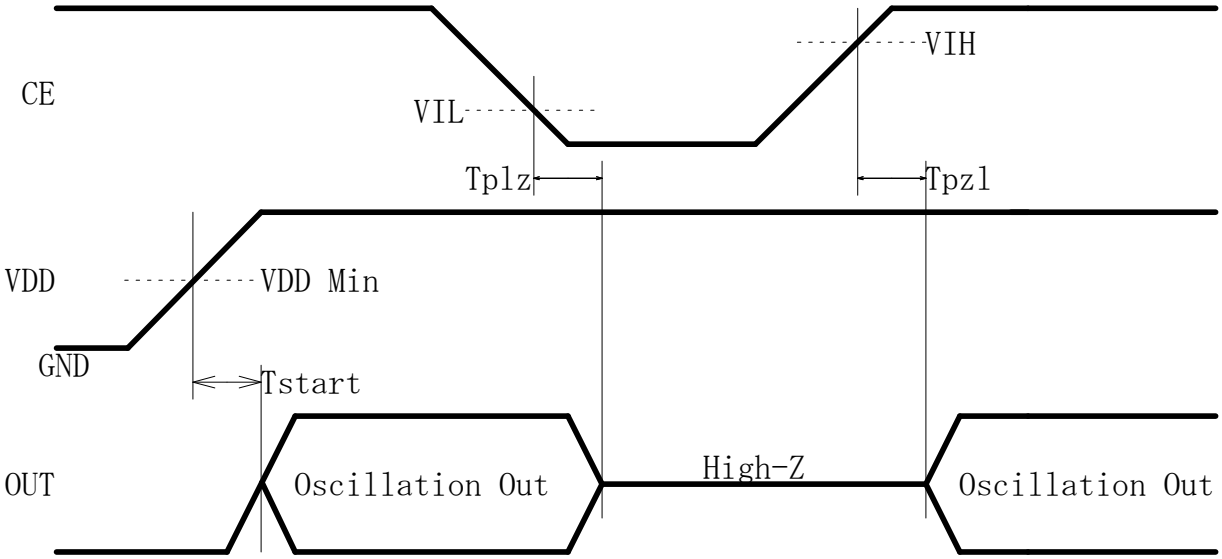
Unless otherwise stated, $V_{DD}$=1.6V~5.5V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | Specification | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Out put Leak current | Iz | CE=0V, X1=$V_{DD}$, Vss<br>Vout=Vss~$V_{DD}$ | | | 20 | μA |
| "H" input current | $I_{IH}$ | CE pad, $V_{IH}$=$V_{DD}$ | | 0.01 | 0.15 | μA |
| "L" input current | $I_{IL}$ | CE pad, $V_{IL}$=0V | -1.45 | -1.25 | | |
| Output Disable Time | Tplz | OUT pad | | | 0.1 | μs |
| Output Enable Time | Tpzl | OUT pad | | | 2.0 | ms |
| Osc. start up time | Tstart | $V_{DD}$>1.6V | | | 2.0 | ms |
| "H" output voltage | $V_{OH}$ | OUT pad, $I_{OH}$=-0.4mA | 0.9$V_{DD}$ | | | V |
| "L" output voltage | $V_{OL}$ | OUT pad, $I_{OL}$=0.4mA | | | 0.1$V_{DD}$ | V |
| Current consumption | $I_{DD}$ | No Load, $V_{DD}$=3.63V<br>f=16.777MHz, CE≧$V_{DD}$-0.3V | | 38 | 58 | μA |
| | | No Load, $V_{DD}$=5.5V<br>f=16.777MHz, CE≧$V_{DD}$-0.3V | | 45 | 80 | |
| | | No Load, $V_{DD}$=3.63V<br>f=27MHz, CE≧$V_{DD}$-0.3V | | 64 | 97 | |
| | | No Load, $V_{DD}$=5.5V<br>f=27MHz, CE≧$V_{DD}$-0.3V | | 75 | 120 | |
| Current consumption at oscillation disable | $I_{DDD}$ | CL=15pF, $V_{DD}$=3.3V<br>CE≦0.3V | | 1.0 | 3.0 | μA |
| Freq. $V_{DD}$ deviation | Fvst | $V_{DD}$=3.3±10% | | | ±1.0 | ppm |
| Output Duty Ratio | Duty | 1/2$V_{DD}$ point | 45 | | 55 | % |
| Rise/Fall time | Tr/Tf | 10%~90%$V_{DD}$, CL=15pF<br>$V_{DD}$=1.62V~2.5V | | 14.0 | 21.0 | ns |
| | | 10%~90%$V_{DD}$, CL=15pF<br>$V_{DD}$=2.5V~5.5V | | 8.0 | 12.0 | |




$$Duty = \frac{T_{WH}}{T_{WH} + T_{WL}} \times 100\%$$

Fig. 5-1 Output wave form (Duty, Tr, Tf, $V_{OH}$, $V_{OL}$)




$V_{IH}$ : Threshold voltage for Oscillation Start
$V_{IL}$ : Threshold voltage for Oscillation Stop

Fig. 5-2 Input output signal timing

## 6. Circuit Parameters of Oscillator (Reference Data for Circuit Design)

Ta=25℃

| Parameter | | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Equivalent series (Loading) Capacitance | | CLxtal | $V_{DD}$=3.3V, f=16MHz | | 3.3 | | pF |
| Drive Level | IPS009BL9 | DL | $V_{DD}$=3.3V, f=16MHz | | 15 | | μW |
| | IPS009BL9A | | | | 1.7 | | |
| Feedback Resistor | | Rf | | | 300 | | kΩ |
| Driving Resistor | IPS009BL9 | Rd | | | 600 | | Ω |
| | IPS009BL9A | | | | 1000 | | |
| Oscillation Capacitor | | Cg | | | 6.0 | | pF |
| | IPS009BL9 | Cd | | | 8.0 | | pF |
| | IPS009BL9A | | | | 2.0 | | |

*The above values are the design values and are not guaranteed by test.

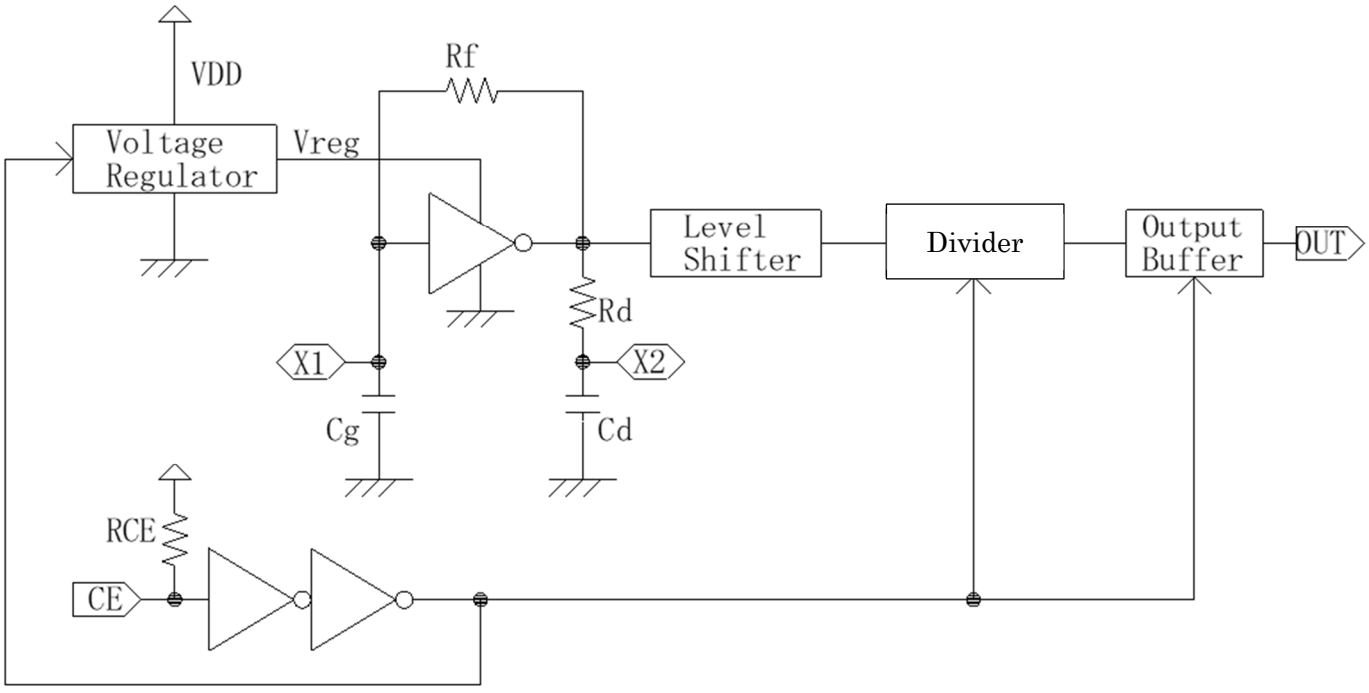
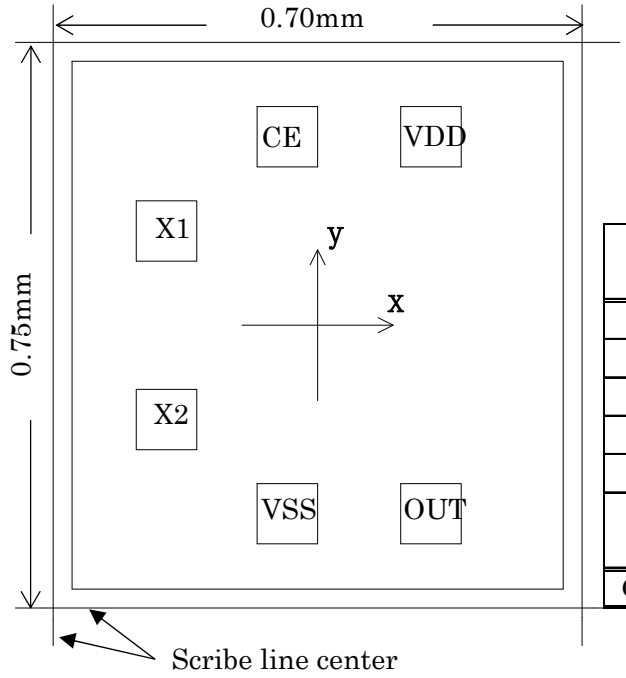


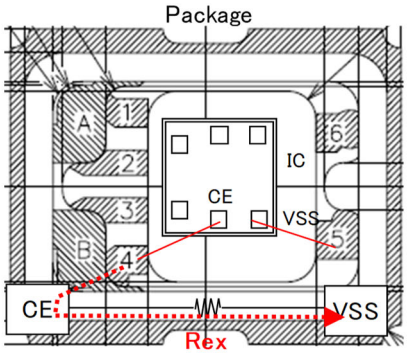

Fig. 6-1 Block Diagram

## 7. Pad Layout




- Die Size: 0.70mm × 0.75mm
- Pad Size: 80um □
- Thickness: 150um±20um
- IC Backside: Gnd or Open

| Pad Name | Function | Location (μm) | |
|---|---|---|---|
| | | x | y |
| VDD | (+) Power Supply | 152 | 244 |
| OUT(Q) | Frequency Output | 152 | -244 |
| VSS | (−) Ground | -39 | -244 |
| X2 | Crystal Drive | -209 | -133 |
| X1 | Crystal Feedback | -209 | 133 |
| CE | Oscillation stop<br>"L": High-Impedance | -39 | 244 |
| Chip Center | | 0 | 0 |




### IMPORTANT Notice for CE function

※ Oscillation will not be activated when CE=Open after CE=Low if Rex is not large.

※ Reference value of Rex is over 10MΩ with CE=Open usage.

※ There is no such issue with CE=VDD usage.

Rex： Resistance value between CE and VSS of package